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MANNED SPACE FLIGHT NETWORK POSTMISSION REPORT FOR RANGER C AND D

JULY 26, 1965

NASA — GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

MANNED SPACE FLIGHT NETWORK

POSTMISSION REPORT

FOR

RANGER C AND D

July 26, 1965

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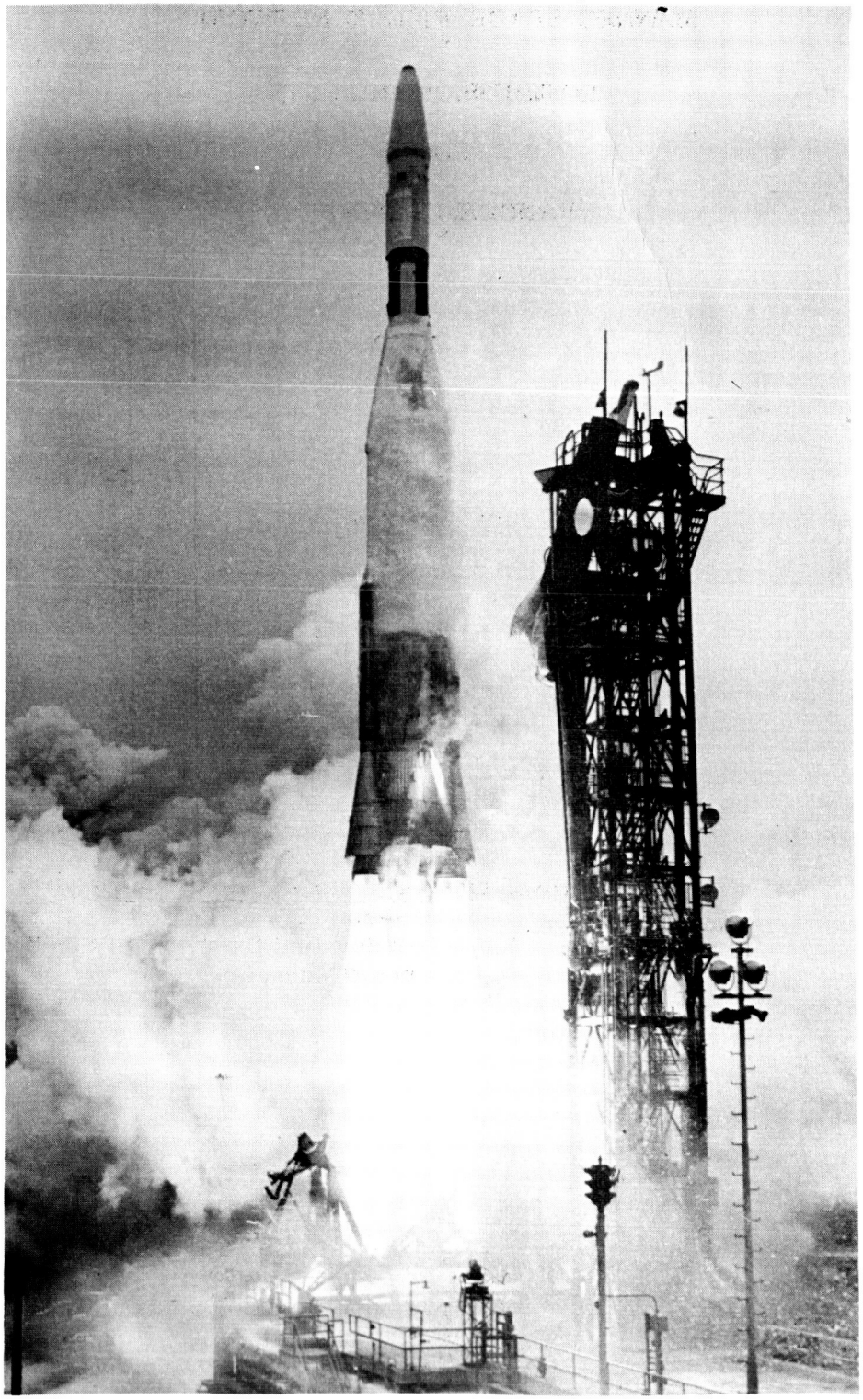

Liftoff of the Atlas Agena Launch Vehicle,
March 21, 1965, Cape Kennedy

SUMMARY

Ranger C was successfully launched from Cape Kennedy on February 17, 1965. Ranger D was successfully launched from Cape Kennedy on March 21, 1965. Both vehicles were launched from complex 12 on a flight azimuth of 105 degrees east of true north. The results achieved were as planned and both missions were a complete success.

The primary objective of both missions was to obtain television pictures of the lunar surface at locations near the intended point of manned landing and with sufficient definition to aid in the design of manned lunar vehicles.

Manned Space Flight Network responsibilities for both missions were as follows: (1) provide real-time radar data to the computing center, (2) refine and update the orbit, (3) receive and record telemetry data, and (4) provide range safety.

For both Ranger missions, the Goddard Space Flight Center computing center reformatted Carnarvon teletype radar data but did not provide real-time on-line support. The computer functions were relayed to the Eastern Test Range Real-Time Computer Facility.

The Manned Space Flight Network provided radar data until loss of signal at Carnarvon, and full telemetry support until battery decay. Real-time computing support was provided by the Eastern Test Range Real-Time Computer Facility for both missions. The National Aeronautics and Space Administration Global Communications Network provided voice and teletype communications between Goddard, Cape Kennedy, and all participating stations; and high-speed data circuits between Goddard and Cape Kennedy, and between Goddard and Bermuda. All network systems performed well for the duration of the mission.

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Table 1. MSFN Station Participation for Ranger C and D

Station		Telemetry	Radar	SCAMA	TTY
Mission Control Center Cape Kennedy	(MCC-K)			X	X
Bermuda	(BDA)	X	X	X	X
Kano, Nigeria*	(KNO)			X	X
Tananarive	(TAN)	X		X	X
Carnarvon, Australia	(CRO)	X	X	X	X
ETR Complex**					
Cape Kennedy, Florida	(CNV)		X		X
Patrick AFB, Florida	(PAT)		X		X
San Salvador Island	(SAL)		X		X
Antigua	(ANT)		X		X
Ascension Island	(ASC)		X		X
Pretoria, South Africa	(PRE)		X		X

*KNO supported as a communication relay station for TAN.

**Although Department of Defense (DOD) sites are shown in this table, their performance is not reflected in this document.

1. INTRODUCTION

This report covers the orbital portions of the Ranger C and D missions through loss of signal (LOS) at Carnarvon (CRO).

A brief critique of the performance of the Manned Space Flight Network (MSFN) for Ranger C and D is presented in this report. It is prepared for those who have some familiarity with the network systems, and concentrates primarily on troubles experienced without emphasis on those systems which performed as expected.

The flight plan for both missions was to launch an Atlas D Mod II first stage and an Agena B second stage, with a Jet Propulsion Laboratory (JPL) designed Ranger spacecraft as the payload. Following launch, both spacecraft were inserted into coasting or parking orbits. A second ignition and burn of the Agena boosters was followed by separation of the spacecraft and injection into translunar trajectories. Following a suitable tracking period, midcourse maneuvers were performed aligning the cameras for TV pictures. The TV systems were actuated by command from JPL at Goldstone, California, 15 minutes before impact. Both Ranger missions performed as planned and excellent results were achieved.

The general network requirements were (1) to provide real-time computation support through injection and LOS, (2) to provide C-band radar beacon tracking through LOS, and (3) to receive and record the Agena telemetry link until battery decay or retromanuever. All of the MSFN stations that participated in the missions and the support provided by each station are listed in table 1.

The next section in this report reviews the network mission preparations; next are summaries of performance of the basic on-station systems, and the computing and ground communications systems.

2. NETWORK SUPPORT PREPARATIONS

2.1 DOCUMENTATION

The Ranger C and D mission requirements being similar, one Network Operations Plan (NOP), dated February 3, 1965, was published for use during both missions.

2.2 EQUIPMENT TESTING

The following Brief System Tests (BST's) were performed to ensure network readiness:

Acquisition Aid

BST-110 and BST-210

Radar

BST-201(C), FPQ-6 Radar (CRO)
BST-101(C) and BST-105(C), FPS-16 Radar (BDA)

Telemetry

BST-106 and BST-206

2.3 NETWORK STATUS AT LAUNCH

All network systems were GREEN and ready to support the launch at liftoff.

3. SYSTEM PERFORMANCE

3.1 RANGER C

3.1.1 Acquisition Aid

A. General

The acquisition aids tracked the Agena booster link (244.3 mc), providing pointing data to the radar antennas. Acquisition aid performance was normal at all stations with no reported equipment malfunctions. Acquisition aid coverage is indicated in table 2.

Table 2. Acquisition Aid Coverage, Ranger C

Station	Acquisition of Signal (AOS)	Loss of Signal (LOS)	Contact Time (min)
BDA	17:08:33Z	17:15:58Z	7.42
TAN	17:35:08Z	18:19:50Z	44.70
CRO	17:42:57Z	19:55:30Z	132.55

B. Station Performance

1. BDA

Both acquisition aids provided 100 percent coverage, each tracking in the semiauto mode for 7 minutes and 22 seconds. Acquisition aid No. 1 experienced no dropouts or interference; acquisition aid No. 2 experienced a small amount of interference which did not seriously affect the track.

2. TAN

The TAN acquisition aid tracked in manual mode expect for a 4-minute, 6-second auto azimuth track. Weak signals were received and frequent dropouts were experienced throughout the pass.

3. CRO

Both CRO acquisition aids tracked full auto for 2 hours 6 minutes and 40 seconds. The signal was solid with only one noticeable droput at 18:19:50Z which lasted for approximately 2 seconds. Track was interrupted at 18:19:40Z when the signal became noisy. The remainder of the pass was normal.

3.1.2 Telemetry

Telemetry operation was nominal with the exception of a recorder failure at CRO and noisy signals received at TAN. BDA recorded both the Atlas (229.890 mc) and the Agena (244.30 mc) links with no malfunctions. Real-time readouts were nominal. Telemetry coverage was provided as indicated in table 3.

Table 3. Telemetry Coverage, Ranger C

Station	AOS	LOS	Total (sec)
BDA	17:08:36Z	17:15:55Z	439
TAN	17:34:03Z	18:19:30Z	2,727
CRO	17:43:00Z	18:49:00Z	3,960

3.1.3 Radar

Radar performance was normal at both BDA and CRO with no malfunctions reported. C-band radar support was provided as indicated in table 4.

Table 4. Radar Coverage, Ranger C

Station	AOS	LOS	Total (sec)
BDA	17:10:00Z	17:16:00Z	360
CRO	17:49:28Z	19:54:33Z	7,505

Agena C-band beacon characteristics prior to liftoff were as follows:

Radar interrogate frequency . . . . . 5788 mc

Transponder frequency . . . . . 5764 mc

Pulse coding . . . . . Single pulse

Beacon delay . . . . . 2.6 μsec (408 yds)

3.2 RANGER D

3.2.1 Acquisition Aid

A. General

The acquisition aids tracked the spacecraft, providing acquisition data to the radars. All network systems performed satisfactorily with no malfunctions reported. Acquisition aid coverage was provided as indicated in table 5.

Table 5. Acquisition Aid Coverage, Ranger D

Station	AOS	LOS	Total (sec)
BDA	21:40:39Z	21:48:01Z	442
TAN	22:02:26Z	22:41:04Z	2,318
CRO	22:25:32Z	22:43:27Z	1,075

B. Station Performance

1. BDA

Both BDA acquisition aids provided 100 percent coverage, each tracking the Agena link (244.3 mc) in the cross-correlation mode, 300-kc bandwidth. No dropouts or interference was experienced.

2. TAN

The TAN acquisition aid tracked in full auto for 1,176 seconds. The signal was reported weak. The Ground Elapsed Time (GET) clock installed at the acquisition aid console for Ranger D proved helpful to the operator.

3. CRO

The tracking signal at CRO was considered poor with a maximum of 10 db over threshold. Track was 100 percent manual.

3.2.2 Telemetry

A. General

Telemetry performance was normal at all stations except CRO with no equipment malfunctions reported for this mission. The marginal operation of the CRO telemetry could be expected considering the low preamplifier input signal level. Telemetry coverage was provided as indicated in table 6.

Table 6. Telemetry Coverage, Ranger D

Station	Frequency	AOS	LOS	Total (sec)
BDA	244.3	21:40:40Z	21:48:00Z	440
	229.89*	21:40:40Z	21:47:34Z	414
TAN	244.3	22:02:26Z	22:41:04Z	2,318
CRO	244.3	22:25:31Z	22:39:00Z	809

*Atlas telemetry link

B. Station Performance

1. BDA

BDA recorded both the Atlas and the Agena Telemetry links, with all systems performing normally. The NRZ (non-return to zero) to RZ (return to zero) converter was used for the first time. Prior to liftoff, the NRZ system was adjusted, using a Ranger C tape playback. In plus time, the decommutator locked up immediately upon acquisition. The nonstandard IRIG (Interrange Instrumentation Group) channel E did not lock up. Although no real-time recording was required, the following Agena and Atlas segments were monitored:

Agena IRIG 15-45	Spacecraft separation
Agena IRIG 15-40	3 degrees/second yaw maneuver
Agena IRIG 15-43	Yaw gyro attitude
Agena IRIG 15-33	Pitch gyro attitude
Agena IRIG 15-23	Roll gyro attitude
Atlas IRIG E-1	Sustainer chamber pressure

No malfunctions occurred, however, Atlas channel E requires a minimum 2700-cps low pass filter and none was available. A 2100-cps low pass filter was used and the system could not be locked on the Ranger C tape or Ranger D filter. A request has been made for a 2700-cps low pass filter.

2. TAN

TAN received the Agena link for 2,318 seconds with no reported malfunctions.

3. CRO

CRO reported the signal too low for discriminator lockup. Maximum signal level at the preamplifier was estimated to be −140 dbw.

During prepass calibrations, noise was noted on antenna No. 1 signal strength recording (Sanborn trace). This noise was not in evidence during the boresight radiated check of postpass calibrations and was probably due to an intermittent patch.

3.2.3 Radar

All network systems performed satisfactorily with no reported malfunctions. The BDA and CRO radars provided support as indicated in table 7.

Table 7. Radar Coverage, Ranger D

Station	AOS	LOS	Total (sec)
BDA	21:40:39Z	21:48:02Z	443
CRO	22:28:42Z	22:44:30Z	948

4. NASCOM PERFORMANCE

4.1 GENERAL

Table 8 shows NASA communications (NASCOM) circuits implemented for both the Ranger C and D missions.

Table 8. NASCOM Configuration

Station	Routing Indicators	Voice	TTY	High-Speed Data (HSD)
BDA	GBDA	X	X	X
MCC-K	GMCC	X	X	X
GSFC	GSPA	X	X	X
CRO	ACRO	X	X	—
TAN	LTAN	X	X	—

The subswitching centers at London (LDN) and Adelaide (ADE) supported as required. KNO was used as a communications relay point for TAN. Communications at TAN for Ranger were reported much better than for previous missions.

4.2 CIRCUIT PERFORMANCE

During Ranger C, teletype circuits between ADE and Perth were out from 1825Z to 1945Z. No malfunctions were reported during Ranger D.

During Ranger C, the SCAMA (Switching, Conferencing, And Monitoring Arrangement) level at CRO was intermittent until about 1945Z due to the failure of the ADE to Perth circuits. No malfunctions were reported for Ranger D.

5. DATA HANDLING

Table 9 lists the data provided for the Ranger C and D missions.

Table 9. Data Recording

Data	Stations		
	BDA	TAN	CRO
Acquisition Aid			
Function Records			
System Operator's Logs	X	X	X
Summary Message	X	X	X
Telemetry			
Magnetic Tape	X	X	X
Signal Strength Records	X	X	X
System Operator's Logs	X	X	X
Summary Message	X	X	X
Radar (C-band)			
Digital Magnetic Tape	X		X
Function Records	X		X
Events Records	X		X
System Operator's Logs	X		X
Summary Message	X		X
M&O Report			
NDR-7	X	X	X

Radar plotboard records were forwarded to range safety personnel at Cape Kennedy.